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EXERCISE/EXERCICE: New Horizons

AWACS – THE CANADIAN FORCES' MISSING LINK

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ABSTRACT

The Government of Canada and Department of National Defence have re-evaluated national security and sovereignty requirements in light of current and perceived threats. A thrust towards enhanced surveillance and command and control has driven acquisition initiatives concerning radar, satellite, unmanned aerial vehicles and maritime patrol aircraft which, by themselves cannot achieve the solution sought by government. The missing link is Airborne Warning and Control System (AWACS), which provides command, control, communications and surveillance over land, sea and in the air coupled with the advantage of maneuver. This paper demonstrates how an AWACS capability would benefit the CF throughout its full spectrum of domestic and expeditionary operations by complementing existing plans for space, land, maritime air and UAV surveillance and reconnaissance assets, as well as expand on contribution to NORAD, NATO and future Coalition partnerships.

"With it [AEW&C] you win, without it you lose."[1] [2]

INTRODUCTION

Canada has been forced to re-evaluate how it will protect its national interests, project influence and national power around the globe. As the world's second largest country geographically, bordering upon three oceans, along with a relatively small population, Canada faces unique challenges in protecting its key interests, particularly given its abundance of renewable and non-renewable natural resources. As a G8 nation, Canada has a desire to be viewed as a world player and impart influence on the world stage. Commitments to bilateral and multilateral alliances and organizations such as North American Aerospace Defence (NORAD), North Atlantic Treaty Organization (NATO) and the United Nations (UN) ensure a broad sense of security, however national security and sovereignty are demanding more unilateral action than ever before. These and other stresses impose high demands on the Canadian Forces (CF) as it struggles to meet domestic and international operational demands.

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[1] Carlo Kopp, "Wedgetail: Australia's 'Pocket AWACS'," *Air Power Australia* (June 1999, 2005) [journal on-line]; available from http://www.ausairpower.net/TE-Wedgetail-99.html; Internet; accessed 27 February 2007. Statement made by Kim Beasley, Australian Minister of Defence 1984-1990 and Deputy Prime Minister 1995-1996. Dr Carlo Kopp is a founding member of *Air Power Australia,* and a prominent authority in Australia in military aviation, radar exploitation for data link applications, and information systems. He is Research Fellow in Regional Military Strategy at the Monash Asia Institute.

[2] AEW&C is short for Airborne Early Warning and Control. It is interchangeable with AWACS, short for Airborne Warning and Control System. AWACS will be predominately used throughout the paper.

The tragic events of September 11, 2001 (9/11) forever changed the way Canada viewed its national security and that of its allies. Within hours of the terrorist attacks that day, thousands of aircraft were grounded, North American airspace closed, and over 400 fighters and a carrier air wing were patrolling the skies of North America.[3] Commenting about that fateful day, LGen Findlay, then Deputy Commander NORAD stated, "We were not ready for something inside the US or Canada. We did not have the situational awareness we truly needed."[4] The sudden awareness of vulnerability to vital national interests resulted in additional responsibilities and realignment for several federal government departments, increased national security requirements and brought about transformation of the CF to meet current and future needs both domestically and abroad. Throughout this process, new policy statements such as *International Policy Statement for Defence* (IPS) and the *Defence Policy Statement* (DPS) have been made by the Government of Canada (GoC) and within the Department of National Defence (DND) with the intent of forging the way ahead in terms of strategy and capability to set conditions for the country to be well poised for challenges to come. In its IPS, the government states the CF must be, "…well adapted to the evolving security environment and ready to respond to the country's future needs."[5] It cites the capability to conduct surveillance throughout the entire country, its airspace and maritime approaches, as well

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[3] LGen Eric Findley, "NORAD: Air and Maritime Defence," *Vanguard*, October/November 2006, 10.

[4] Findley, NORAD: Air and Maritime Defence . . .,10.

[5] Department of National Defence, *Canada's International Policy Statement. A Role of Pride and influence in the World: Defence* (Ottawa: Canada Communication Group, 2004), 1.

as the ability to respond to asymmetric threats as one of the most critical security issues.[6] The resulting strategy to address this concern is reflected in part by tasking the CF to acquire unmanned aerial vehicles (UAV) and pursue the use of satellites to support domestic and international operations.[7] Subordinate policy set by DND such as the Air Force's *Strategic Vectors* and the CF's *Report on Plans and Priorities* (RPP) amplify this task with a danger of relying exclusively on technology that is not designed, nor intended to provide for solutions sought by government.

Through examination of GoC and DND policy, it is evident there are misunderstood priorities leading to a large capability gap between what the GoC wants for its defence strategy, what has been tasked for the CF to acquire and place emphasis on, and what the CF actually needs to meet domestic and expeditionary aerospace operational requirements in conjunction with CF transformation. Reach, endurance, ability to conduct wide-area surveillance of airspace and ocean surface, and ability to exercise command, control and communications (C^3) simultaneously is the missing link between limited satellite, UAV and maritime patrol aircraft (MPA) coverage, neither of which can perform C^3 across the full spectrum of joint and combined operations. The Airborne Warning and Control System (AWACS) provides for all of these requirements and much more. It will be shown how an AWACS capability would benefit the CF throughout its full spectrum of domestic and expeditionary operations by complementing existing plans for space, land, maritime air and UAV surveillance and reconnaissance

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[6] Department of National Defence, *Canada's International Policy Statement . . .*, 16.

[7] *Ibid*., 14.

assets, as well as expand on contribution to NORAD, NATO and future Coalition partnerships.

BACKGROUND

The AWACS capability is not new and neither is the Canadian appreciation for its reputation as a vital enabler of air operations as evidenced by the GoC's continued commitment to maintain CF members serving in the AWACS Force of both NORAD and NATO,[8] the fact that Canada is the third largest contributor of funds and personnel to NATO AWACS[9], and through recent expansion of NORAD's mission to include maritime warning in its renewal of the agreement in 2006[10]. This section examines broad capabilities of AWACS, along with space-based sensors, land-based air surveillance radars, MPA and UAVs so they may be compared with one another to highlight the capability gap for AWACS within the CF.

AWACS Capabilities. There are varying capabilities and platforms worldwide operating as AWACS ranging from helicopters to turbo-prop to converted commercial airliners. The CF provides a cadre of pilots and Aerospace Controllers (AEC) to both the NATO and US AWACS fleets operating the E3A/B/C Sentry based on the Boeing 707 airframe. The United Kingdom uses the E3D version of the Boeing 707, while the

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[8] *Ibid*., 20.

[9] Department of National Defence, *Strategic Vectors: The Air Force Transformation Vision* (Ottawa: Canada Communication Group, 2004), 73.

Japanese use the much larger wide-bodied Boeing E-767. These aircraft are very large, expensive and operate the AN/APY-1 or AN/APY-2 rotodome multi-function radar.[11] They are capable of operating to ranges of 4000-5000nm, endurance in excess of 13 hours, speeds exceeding 800km/h(450kts) and carry flight and mission crews of up to 22 personnel.[12] The AN/APY-2 radar permits exploitation of radar propagation within radar horizon or beyond. Its maritime mode can be used to detect moving or stationary surface ships by blanking out sea clutter and land mass. The radar has interleaving capabilities that enable air-to-air and maritime surveillance simultaneously.[13] The maximum detection range for air targets is in excess of 325nm(550km), and maritime targets within the radar horizon (dependant on altitude). At normal operating altitude of 30,000 feet, this radar could cover an area of up to 155,625nm²(320,000km²) while taking advantage of its ability to constantly maneuver.[14]

One of the newest, medium scale AWACS available is the Boeing 737-700, nicknamed 'Wedgetail' for Australia's Air 5077 project,[15] and 'Peace Eagle' for the Turkish and South Korean version.[16] With a range of between 3500-5500nm (external

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[10] Paul H. Chapin, "NORAD: Renewing a Unique Partnership," *Vanguard*, October/November 2006, 14.

[11] Jane's. *Jane's Radar and Electronic Warfare Systems 2003-2004* (Surrey,UK: Jane's Information Group Ltd, 2003), 192.

[12] Jane's. *Jane's Electronic Mission Aircraft – Issue Thirteen – June 2004* (Surrey,UK: Jane's Information Group Ltd, 2003), 42.

[13] Jane's. *Jane's Electronic Mission Aircraft – Issue Thirteen – June 2004* . . ., 42.

[14] North Atlantic Treaty Organization, "AWACS: NATO's Eyes in the Sky," http://www.nato.int/issues/awacs/tasks.html; Internet; accessed 23 January 2007.

[15] Nigel Pittaway, "Boeing 737 AEW&C: Project Wedgetail," *International Air Power Review*, Vol 19 (2006): 34.

fuel tanks dependant), endurance of up to 9 hours on station, speeds exceeding 800km/h(450kts),[17] this aircraft is compatible with major aerodromes worldwide, while still being able to deliver performance commensurate with its larger peers. Wedgetail uses the Multi-Electronic-Sensor-Array (MESA) radar and usually operates with a flight and mission crew of approximately 14-16. The MESA radar detects air targets in excess of 216nm(400km) and 162nm(300km) against surface ships.[18] [19] This equates to continuous coverage greater than 46,656nm²(100,000km²) depending on altitude and mode selected.

Several smaller, more tactical AWACS are available such as the E2C Hawkeye turboprop operated by the US Navy from its carriers for Fleet Air Defence, and the converted C-130H Hercules turbo-prop transport aircraft operated by US Customs and Coast Guard.[20] These aircraft have a more limited range from 2800-3400nm, speed of approx 350kts(600km/h) and endurance of 9 to 13 hours respectively. Both use the AN/APS-145 radar with capability out to 325nm(550km) for a continuous search area of 105,625nm²(320,000km²).[21]

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[16] Deagel.com, "737 AEW&C," http://www.deagel.com/Tactical-Support-Airplanes/737-AEWandC_a000486001.aspx; Internet; accessed 27 February 2007.

[17] Jane's. *Jane's Electronic Mission Aircraft – Issue Thirteen – June 2004* (Surrey,UK: Jane's Information Group Ltd, 2003), 9.

[18] Nigel Pittaway, "Boeing 737 AEW&C: Project Wedgetail," *International Air Power Review*, Vol 19 (2006): 38.

[19] Jane's. *Jane's Electronic Mission Aircraft – Issue Thirteen – June 2004* (Surrey,UK: Jane's Information Group Ltd, 2003), 14.

[20] Carlo Kopp, "Wedgetail: Australia's 'Pocket AWACS'," *Air Power Australia* (June 1999, 2005) [journal on-line]; available from http://www.ausairpower.net/TE-Wedgetail-99.html; Internet; accessed 27 February 2007.

[21] Jane's. *Jane's Electronic Mission Aircraft – Issue Thirteen – June 2004* (Surrey,UK: Jane's Information Group Ltd, 2003), 74, 77, 94, 109.

Despite differences in flight characteristics and sensor capability, all of these platforms have many other features in common. All have ability to communicate on multiple circuits via satellite, UHF, HF and VHF AM/FM radio and exchange common operating picture (COP) via data links 4, 11 and 16. All have air-to-air refueling capability further extending reach and endurance. All have passive(ESM) and direction-finding(DF) Electronic Warfare(EW) systems for detection, localization and identification of signals within the electro-magnetic spectrum.[22] [23] [24] All have the ability to assume air traffic control(ATC), air intercept control(AIC) and advanced air battlespace management(AABM) activities, while liaising and deconflicting the airspace with civilian ATC agencies.[25] In essence, these AWACS are true C³ platforms with exceptional sensor detection and identification suites capable of wide-area surveillance and directing offensive or defensive counter-air(OCA/DCA) over land or sea. They can further serve as a communications node or relay over great distance due to extended line-of-sight (LOS) ranges when operating at high altitude and offer tremendous flexibility due to their rapid deployability.

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[22] Jane's. *Jane's Electronic Mission Aircraft – Issue Thirteen – June . . .*, 42.

[23] Global Security.org, "E-767 Airborne Warning and Control System," http://www.globalsecurity.org/military/systems/aircraft/e-767-specs.htm; Internet; accessed 6 April 2007.

[24] North Atlantic Treaty Organization, "AWACS: NATO's Eyes in the Sky," http://www.nato.int/issues/awacs/tasks.html; Internet; accessed 23 January 2007.

[25] Carlo Kopp, "Wedgetail: Australia's 'Pocket AWACS'," *Air Power Australia* (June 1999, 2005) [journal on-line]; available from http://www.ausairpower.net/TE-Wedgetail-99.html; Internet; accessed 27 February 2007.

Space-based Surveillance. Canada does not currently have dedicated satellites for military application. Instead, the CF relies on commercial satellites to provide surveillance data in which follow-on analysis produces an intelligence product from which decisions and action can be taken. The system employed largely by the CF is Canadian owned and operated RADARSAT 2. At a cost of $642M (CAD), Jane's claimed this system to be the, "world's most powerful commercial radar remote sensing satellite totally dedicated to operational application" in 2003.[26] Among several applications available, coastal zone and ocean monitoring are of significant interest to the CF. The orbit of RADARSAT 2 facilitates coverage of all of Canada every 72 hours, and the Canadian Arctic once daily. Data is available to the CF within 4 hours of acquisition.[27] The product is a snapshot in time of wide-area surveillance with no provision for surface or air tracking. Significant consideration must be given to reliability due to competing interests of a growing customer base of which the CF is only one of many. There is limited flexibility for dedicated revisit of a region of special interest for more persistent coverage or facilitate tracking. There is also risk that costs could balloon due to foreign government and commercial industry's purchase of time slots, and influence to alter the orbit to achieve better coverage where the customer demand is. These risks could leave the CF with inconsistency and large holes in surveillance coverage for unpredictable periods of time.

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[26] Jane's. *Jane's Space Directory 2003-2004* (Surrey,UK: Jane's Information Group Ltd, 2003), 403.

[27] Jane's. *Jane's Space Directory 2003-2004* . . ., 403.

Land-based Surveillance Radar. There is a wide variety of radars available for air and surface surveillance, some of which are permanent structures while others are transportable and are dependant on specifics of the task they are intended for. For later comparison with AWACS, modern examples of NORAD's North Warning System (NWS) radar, deployable tactical radar and surface wave radar will be covered.

The AN/FPS-117 Air Defence Radar is designed for long range air detection, IFF interrogation, provision of navigational assistance and tactical control for counter-air and close air support operations.[28] Canada acquired four sets for use in the Canadian Coastal Radar Programme and an additional eleven were installed as permanent fixtures of the NWS and remoted to the Canadian Air Defence Sector (CADS). They have a range of approximately 288km(150nm) and cost approximately $4M (USD) each in 2004.[29]

The AN/TPS-59(V) Tactical Radar is a 3D long-range air surveillance radar. Despite a 45m² rotating phased array antennae, it can be installed as a permanent fixture or deployed for expeditionary operations. For the latter, it requires three trailers and four hours setup time. It has a maximum detection range of approximately 550km(325nm) against aircraft, and 740km(370nm) for a Theatre Ballistic Missile (TBM).[30] Both the AN/FPS-117 and the AN/TPS-59(V) are designed for airspace surveillance and would have limited surface detection capability beyond their radar horizon.

Canada's High Frequency Surface Wave Radar (HFSWR) was designed to detect and track ships, aircraft and ice formations to ranges of 400km(200nm). In testing,

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[28] Jane's. *Jane's Radar and Electronic Warfare Systems 2003-2004* (Surrey,UK: Jane's Information Group Ltd, 2003), 37.

[29] Jane's. *Jane's Radar and Electronic Warfare Systems 2003-2004* . . ., 37.

it showed great promise with detection ranges of up to 324km(162nm) against trawlers 12m in length and 400km(200nm) against a ship 190m in length.[31] Unfortunately, after $39M (CAD) invested, the CF had to cancel this project in the fall of 2006 due to concerns over the radar's interference with commercial use of the electronic spectrum as well as other performance-related issues. Two sites remain as experimental sites in prospect of reviving the project at a future date.[32]

Maritime Patrol Aircraft (MPA). The CF's fleet of CP140 Auroras (based on the USN P3C Orion) are designed for long range maritime patrol in support of anti-submarine warfare (ASW). These aircraft have a cruising speed of 328kts(500km/h), 12 to 17 hour endurance and a range of 2500nm low altitude or 3800nm high altitude.[33] They employ the AN/APS-504(V) surface search radar capable of sector search from 30º to 120º wide to a maximum range of 370km(185nm).[34] While an excellent radar for surface detection, it has no air-to-air capability. The CP140 is not Link16 fitted and is extremely limited operating as a C^3 platform.

UAV Capabilities. Given the many variants of UAVs in existence with wide range of intelligence, surveillance and reconnaissance (ISR) equipment and weapons,

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[30] *Ibid*., 39.

[31] *Ibid*., 42.

[32] Defence News.com, "Canada Cancels maritime Surveillance Radar," http://www.defensenews.com/story.php?F=2151982&C=navwar; Internet; accessed 6 April 2007.

[33] Jane's. *Jane's All The World's Aircraft 1991-92* (Surrey,UK: Jane's Information Group Ltd, 1991), 426.

[34] Jane's. *Jane's Radar and Electronic Warfare Systems 1997-98* (Surrey,UK: Jane's

Global Hawk and SPERWER will be covered. The former represents the ultimate in current operational and strategic level surveillance and reconnaissance capability that the CF could seek, while the latter represents what the CF currently operates and will continue employing for the foreseeable future.

> The RQ-4A/B Global Hawk is described by the US Air Force (USAF) as being,
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> … a high altitude, long endurance unmanned aerial reconnaissance system which provides military field commanders with high resolution, near-real-time imagery of large geographic areas…For increased survivability the mission is planned for threat avoidance using available theatre assets such as AWACS…

It has a range of 14,000nm(28,000km), endurance of up to 42 hours, loiter speed of 343kts(575km/h), ceiling of 65,000ft and uses a combination of satellite and LOS communication links to ground forces, permitting operation of the system worldwide. A combination of sensors including Synthetic Aperture Radar (SAR), electro-optic (EO) and infrared (IR) systems enable Global Hawk to conduct surveillance of 40,000nm² over 24 hours. Its surveillance is limited strictly to the surface (maritime or over land) with no capability of detecting or tracking air targets.[35] SPERWER is, "designed to support Intelligence, Surveillance, Target Acquisition and reconnaissance (ISTAR) at the battlegroup level (brigade to division)." A tactical UAV with a range of 200km(100nm), endurance of 6 hours and a speed of 90kts(150km/h),[36] it can carry small EO/IR sensor or a small SAR. It has been in service with the CF since 2003 and employed in

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Information Group Ltd, 1997), 200.

[35] United States Air Force, "RQ-4A/B Global Hawk High Altitude, Long Endurance, Unmanned Reconnaissance Aircraft, USA," http://www.airforce-technology.com/project_printable.asp?ProjectID=1280; Internet; accessed 2 March 2007. Note: This source applies for all data on Global Hawk presented in this paragraph.

[36] Sagem Defense Securite (France), "SPERWER Tactical UAV," http://www.sagem-ds.com/pdf/en/D704.pdf; Internet; accessed 6 April 2007.

Afghanistan. The most recent purchase was five units at a cost of approximately $3M (CAD) each.[37] For the most part, these two UAVs lean more towards employment for directed ISR, fire support, or targeting missions vice general surveillance of large scale area. They have no C^2 capability and are very limited in communications that support only the UAV's mission control.

POLICY AND STRATEGY – ALL THRUST, INADEQUATE VECTOR

In addressing the challenges brought on by government recognition of the critical need for increased surveillance capability along with a new strategy for surveillance and C^3, the function of AWACS has been completely overlooked. Various policy statements are clear on what the CF must do in order to meet the increased C^3 and surveillance needs within the governments three major priorities: defence of Canada; defence of North America in partnership with the US; and expeditionary operations abroad with alliances and coalitions.[38] With air traffic increasing over the Arctic, and a growing presence of maritime traffic in northern waters, the IPS points to, "a greater emphasis being placed on the defence of Canada and North America than in the past" as being "the CF's first priority".[39] It identifies possible threats stemming from terrorism to include "…hijacked aircraft, crop dusters, drones or even cruise missiles launched from container ships or

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[37] DefenseUpdate.com, "SPERWER Tactical UAV System," http://www.defense-update.com/products/s/sperwer.htm; Internet; accessed 2 March 2007.

[38] Department of National Defence, *Canada's International Policy Statement. A Role of Pride and influence in the World: Defence* (Ottawa: Canada Communication Group, 2004), 4.

other platforms off our coasts."[40] The Air Force's *Strategic Vectors* reinforces all of this by identifying requirements to,

> …effectively monitor and detect low-flying, small, fast objects such as cruise missiles that could be used asymmetrically against us, Canada needs better airspace surveillance capabilities, especially over our maritime approaches, cities and critical infrastructure. The Air Force needs to reconfigure its operational posture and acquire improved active control capabilities to be able to effectively control unwanted activity either approaching, or operating within our national airspace.[41]

The CF is expected to, "establish fully integrated units capable of a timely, focused and effective response to foreign and domestic threats to Canadian security,"[42] and, "increase efforts to ensure sovereignty and security of our territory, airspace and maritime approaches, including the Arctic," as well as, "improve on a combination of maritime, land, air and space surveillance systems."[43] The same government policy document specifically identifies tasks for the Air Force which include, "acquisition of additional radars to provide better coverage of population centres and vital areas;"[44] as well as, "increase the surveillance and control of Canadian waters and the Arctic with modernized Aurora aircraft, UAVs and satellites." Regarding this, the CF *Report on Plans and Priorities* states that, "Over the next 15 years, the air force will leverage new technologies to deal with asymmetric threats and will increasingly use space-based

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[39] Department of National Defence, Canada's International Policy Statement . . ., 2.

[40] *Ibid*., 17.

[41] Department of National Defence, *Strategic Vectors: The Air Force Transformation Vision* (Ottawa: Canada Communication Group, 2004), 27.

[42] Department of National Defence, *Canada's International Policy Statement. A Role of Pride and influence in the World: Defence* (Ottawa: Canada Communication Group, 2004), 11.

[43] Department of National Defence, *Canada's International Policy Statement* . . ., 11.

technology, such as satellites for beyond-LOS communications and domain awareness."[45] All of this visionary change has caused the Air Force to rethink its mission as being, "To control and exploit the aerospace environment for military purposes which contribute to Canadian security and national objectives."[46] It further implies the importance of, "…interoperability in the areas of C^3, data sharing, surveillance, warning and active control of aerospace and over maritime areas."[47] This is interesting as there is a recurring theme of 'control' that is reflected throughout the policies discussed. Control is not a function that can be performed by dedicated surveillance assets alone. It requires a combination of input (surveillance), communication, decision-making capacity and ability to effect decisions (C^2) through action.

Having now a broad perspective on what satellite, static radar sites, maritime and UAV patrol capabilities bring, it is clear they play a key role in this complex equation but the lack of AWACS as the intermediate layer is blatantly obvious. AWACS delivers the real-time, immediate maneuver capability that can be harnessed to support not only the surveillance goals of joint and combined warfare as well as 'other government departments' (OGD) in a domestic sense, but bring with it the invaluable C^3 capability that enables action to be taken in response to ISR once obtained, in a more persistent manner.

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[44] *Ibid*., 19.

[45] Department of National Defence, *Report on Plans and Priorities 2006-2007* (Ottawa: Canada Communication Group, 2006), 24.

[46] Department of National Defence, *Strategic Vectors: The Air Force Transformation Vision* (Ottawa: Canada Communication Group, 2004), 38.

[47] Department of National Defence, *Strategic Vectors . . .*, 28.

For the CF, this void in operational capability has existed for three decades but was mitigated by Canadian reliance on its NORAD (United States Air Force fleet of 33 AWACS)[48] and NATO (fleet of 17 AWACS)[49] alliances to fulfill whenever AWACS employment was deemed necessary. This approach worked well for Canada during the Cold War when all parties of both alliances were commonly focused on the ex-Soviet military and other symmetrical military threats. The problem with this approach now, is that Canada's requirements have changed to encompass a greater domestic focus and ability to operate abroad with Coalitions in conjunction with, and other than, NATO. As NATO AWACS exist to serve that alliance's standing defence needs, expeditionary obligations and collective interests, they have become much less available to support Canadian-only interests when desired.

AWACS – THE MISSING LINK

If the CF is going to progress with government desires as set in policy and follow its own strategic visions, it needs to acquire the AWACS capability. It is not possible to achieve the surveillance and C^3 solution by continuing down a path with unrealistic reliance on space and UAV assets that have limited coverage, challenges implementing short-notice change, and poor search area revisit flexibility. Nor will commercial satellite services be able to give the necessary full-time support required for expeditionary

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[48] North Atlantic Treaty Organization, "AWACS: NATO's Eyes in the Sky," http://www.nato.int/issues/awacs/tasks.html; Internet; accessed 23 January 2007.

[49] North Atlantic Treaty Organization, "AWACS: NATO's Eyes in the Sky,". . .

operations in parts of the world where their established orbit does not cover. Equally concerning, is reliance on use of static radar sites with limited flexibility for shifting coverage as required throughout the country or abroad for deployed operations. The maritime air and UAV, although effective for missions directed at specific targets, have no air-to-air capability and could potentially waste significant mission endurance searching with much smaller coverage before finding a target to further investigate, or miss targets of interest altogether. It must be emphasized these assets and resources are not wasted effort, nor should they be dismissed from consideration in assisting with fulfillment of the policies and vision statements that have been reviewed. Instead, they form part of a collective package, which is at best less than a 50% solution without the AWACS. Referring to Australia's acquisition of Wedgetail, Carlo Kopps sums up the AWACS capability nicely as,

> …the essential capability to control the deployment of defensive assets to best advantage against an attacker in aircraft or surface ships, frustrating their manoeuvre strategy. CAPs and SAGs can be positioned to best advantage to block an opponent. No less importantly, it allows the best deployment of offensive assets to bypass an opponent's defensive deployment. In practical terms, this means a strike package can be routed around a defensive CAP, denying them the geometry to close to an engagement. SAGs can be provided with a wide area picture allowing them the choice of engagement geometry, or the choice of avoiding engagement if required.[50]

He points out as well, "the ADF now acquires the ability to precisely coordinate RAAF and RAN combat assets at a broader operational level."[51] Putting this into a Canadian

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[50] Carlo Kopp, "Wedgetail: Australia's 'Pocket AWACS'," *Air Power Australia* (June 1999, 2005) [journal on-line]; available from http://www.ausairpower.net/TE-Wedgetail-99.html; Internet; accessed 27 February 2007.

[51] Kopp, "Wedgetail: Australia's 'Pocket AWACS'," . . .

context, these 'combat assets' could include UAVs and maritime air, while AWACS gets its own cueing from space systems or static ground radar.

In terms of cost for acquiring this capability, there are many platforms to choose from, varying from relatively low cost (E2C) to the extreme (E-767). A breakdown of known programs reported by Jane's in 2004 indicated the approximate cost for acquisition of the E2C Hawkeye was $60M(USD)[52], for 737-700 $200M(USD),[53] while the Japanese E-767 was $400M (USD) each.[54] In comparison, the 737-700 and smaller platforms are a fraction of the cost for the other capabilities Canada is currently invested or intends to invest in. The cost for Global Hawk in 2004 was $35M(USD) apiece[55], the cost for RADARSAT 2 was close to $700M(CAD) for one unit (not including the annual costs for data acquisition and processing), and the cost for the multiple static radars for the NWS in Canada was $1.5B(USD).[56] When these costs are multiplied by the numbers needed to even partially accommodate GoC/CF requirements, AWACS cost effectiveness is apparent; even more so when the C^3 aspect is considered, which the other systems cannot offer.

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[52] Jane's. *Jane's Electronic Mission Aircraft – Issue Thirteen – June 2004* (Surrey,UK: Jane's Information Group Ltd, 2003), 13.

[53] Deagel.com, "737 AEW&C," http://www.deagel.com/Tactical-Support-Airplanes/737-AEWandC_a000486001.aspx; Internet; accessed 27 February 2007.

[54] Richard Aboulafia, "Airborne early Warning: An Affordable Necessity?," *Aerospace America - Industry Insights,* (May, 2001); available from http://www.aiaa.org/aerospace/Article.cfm?issuetocid=86&ArchiveIssueID=13; Internet; accessed 16 April 2007.

[55] Aboulafia, "Airborne early Warning: An Affordable Necessity?," . . ., 13-14.

[56] The Canadian Encyclopedia, "Early Warning Radar," http://www.thecanadianencyclopedia.com/PrinterFriendly.cfm?Params=A1ARTA0002485; Internet; accessed 4 March 2007.

The following paragraphs will illustrate how AWACS would be a significant enabler and force multiplier in the context of operations supporting Canada Command (CANADACOM), Canadian Expeditionary Forces Command (CEFCOM), as well as CF force generation and training.

CANADACOM/OGD: As the organization within the CF directly responsible for all domestic operations within Canada and the North American Theatre, it is the principle conduit between the CF and OGD at federal and provincial levels.[57] With its six Joint Task Force Headquarters throughout Canada, there is requirement for a national COP and domain awareness, plus the ability to control military and, on occasion, civilian assets. Some of the most significant challenges that could face CANADACOM include direct threat to Canadian sovereignty, terrorist attack or natural disaster. In all cases, the ability to project C^3 and surveillance capability to an afflicted area lacking means to communicate is essential. AWACS, such as the 737-700, could fill this role within 4 hours anywhere in the country's southern half (or within 6-7 hours for the extreme north) if positioned in central Canada, and be an enabler for the 'whole of government' approach to a domestic problem. Further, it could be received, refueled and serviced at commercial airports and each of the CF's Forward Operating Bases (FOB) in the Arctic. If forward-deployed, AWACS offers quicker response time, greater on-station endurance with enhanced combat radius relative to the operating area.

If an earthquake struck the west coast, knocking out power and communications over thousands of Km^2, AWACS could provide coordination for air assets flowing into

the area for response, provide radio relay, communications and the COP to CANADACOM via satellite. This concept was utilized during the Hurricane KATRINA response in September 2005, when AWACS from the US Navy, Coast Guard and Customs helped coordinate C³ up to 275 helicopters within the joint operations area(JOA).[58] This type of support is applicable to emergencies striking any of Canada's many remote communities.

In the case of maritime security in northern waters, with theatre-level queuing from tools such as RADARSAT 2, AWACS could be dispatched to conduct higher fidelity search of a wide area, localize tracks of interest and direct CP140 or warships to where effort could be placed on decisive action vice searching. Similarly, for UAVs, AWACS can provide queuing to the ground control station who can then best optimize mission time for the UAV to collect data on targets and shadow targets of interest.

From a security or AD aspect, AWACS is an absolute necessity for DCA response during a terrorist-caused crisis such as 9/11, as well as for coordinating access within restricted airspace for DCA, authorized OGD and civilian aircraft for events such as G8 summits, VIP visits and world events including the Olympics. Canada cannot achieve this type of surveillance and C³ with static ground radar, UAVs and satellites as government and CF strategy would suggest. AWACS is essential. Similar to Greece and Portugal for past world class events,[59] Canada must rely on NORAD or NATO for

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[57] OGD encompasses federal and provincial departments such as Public Safety and Emergency Preparedness Canada (PSEPC), Fisheries and Oceans (DFO), Immigration, Transport and provincial government departments and agencies from province to province.

[58] United States Government Printing Office Access, "Congressional Report: Hurricane Katrina Response," http://www.gpoaccess.gov/serialset/creports/pdf/sr109-322/ch21.pdf; Internet; accessed 4 April 2007.

provision of AWACS for comparable situations at present time. While alliance AWACS assets might occasionally be available to support these missions in peace time, what happens when they are not?

CEFCOM: The added benefit of AWACS to CF elements deployed abroad and as a force multiplier to any coalition would be significant, as would the potential to augment NATO or NORAD in time of crisis. Given CF transformation with emphasis placed on added flexibility to expeditionary operations, AWACS would be highly complementary to a GoC mandated Standing Contingency Force (SCF), and the Air Force's Air Expeditionary Unit (to consist of six CF18s and an A310 air-to-air refueler (AAR)).[60] The combat capability packed into AWACS is in a completely different realm than that of reconnaissance-oriented, tactical SPERWER UAV or surveillance-oriented ground tactical radar. Within the context of AABM, wide-area surveillance, detection and identification, control of friendly air assets, routing of friendly assets away from opposing forces or to merge them for tactical advantage in combat,[61] as well as being the hub of tactical, operational and even strategic level communications, AWACS is invaluable for the Joint Force Commander (JFC).

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[59] North Atlantic Treaty Organization, "AWACS: NATO's Eyes in the Sky," http://www.nato.int/issues/awacs/tasks.html; Internet; accessed 23 January 2007.

[60] Department of National Defence, *Canada's International Policy Statement. A Role of Pride and influence in the World: Defence* (Ottawa: Canada Communication Group, 2004), 29-30.

[61] Carlo Kopp, "Wedgetail: Australia's 'Pocket AWACS'," *Air Power Australia* (June 1999, 2005) [journal on-line]; available from http://www.ausairpower.net/TE-Wedgetail-99.html; Internet; accessed 27 February 2007.

Missions such as Air Interdiction (AI), Counter Air/Sea/Land operations, Maritime littoral and amphibious operations, Combat Search and Rescue (CSAR), C^3 support to air/ground/sea/special operations forces (SOF) and Close Air Support (CAS) are all achievable by the modern AWACS, with unparalleled superiority. With its tremendous advantage for exchanging LOS data and communications, as well as the ability to assimilate multiple data links (4, 11, SADL, 16/MIDS), this asset can fully integrate a theatre level COP generated by a multi-national force. Using Link 16 through satellite or UHF medium, AWACS enables enhanced command decision-making by the JFC and subordinate commanders. With the added complexity of helicopters, fighters, UAVs, Joint Fires, warships and troop maneuver all occurring in close proximity, only assets such as AWACS can handle proper on-scene airspace deconfliction, particularly when Time Sensitive Targeting (TST) against targets of opportunity require action at short notice. Operating complementary to vice competitively, AWACS could provide queuing to UAV control stations or air reconnaissance for localized target areas and for resolving flight routing conflicts with other airborne assets.

For humanitarian missions similar to those discussed in the CANADACOM paragraph, the advantages remain equally valid. A disaster in the third world requiring coordination of massive air movements for rescue and distribution of aid in an environment lacking communications and ATC infrastructure calls for AWACS capability. The current Canadian approach of focusing on satellites, UAVs and MPA alone, will not and cannot fulfill the requirements of the CEFCOM mission or the GoC/CF expeditionary force vision without AWACS augmentation.

FORCE GENERATION (FG) AND TRAINING: AWACS would contribute to CF joint FG and training requirements significantly, and fulfill a role beyond operational scope and capability of UAVs, satellites, ground radar and MPA. It would enable in-country training for AEC officers destined for AWACS duty within NATO or NORAD, as well as provide multi-data link training and assist with sea trials and exercises for maritime forces when proving upgrades and new combat systems. Joint warfare procedures, tactics and communications could be practiced between all three CF elements at theatre level, vital for proving interoperability, technical and tactical proficiency in preparation for deployed operations. For Canada's fighter force, this asset would be invaluable. Crews could train regularly to a far higher standard when operating with AWACS. As the CF18 modernized fleet begins to operate Link16/MIDS and AMRAAM, interaction with AWACS will be necessary. As the CF pushes forward for a possible fighter replacement project like Joint Strike Fighter (JSF), pilots with experience operating sophisticated onboard data link and a mature C^3 capability to manage the high-tech fighter will be needed.

Other benefits include supporting live weapons firings by managing weapons ranges over land and sea. Traditionally, CF18s and warships deployed to US exercise areas for missile firing and precision-guided-munitions (PGM) delivery. The Navy and Air Force recently commenced firing short-range missiles/PGM off both Canadian coasts, however there is no provision for firing long-range weapons such as the Navy's SM2, HARPOON or the Air Force's AMRAAM, each with ranges of over 60nm, due to inability to ensure range safety. This is directly attributed to not having CF capability for continuous volume air and surface coverage over the battlespace needed. AWACS could

achieve this, thereby enabling significant training milestones to be accomplished in Canadian exercise areas instead of deploying maritime and air units abroad to use foreign ranges at tremendous funding expense and time away.

CONCLUSION

AWACS represents a fundamental capability that is missing from CF and GoC strategy to achieve the policy set out in IPS, DPS, *Strategic Vectors* and the RPP. Canadian requirements for enhanced surveillance and C^3 directed towards national security and sovereignty have now concentrated on utilizing satellite, UAV, MPA and radar. These assets, in isolation of AWACS, are not capable of generating the solution sought by government, nor will they provide the CF a robust mechanism for projecting dynamic, flexible surveillance and C^3 for domestic or expeditionary operations abroad. The missing link that could complement these systems and harness combined synergy for C^3 and surveillance is AWACS.

Modestly affordable compared with other ongoing CF initiatives, yet unparalleled in functionality, AWACS brings enhanced capability across the full spectrum of operations conceivable for CANADACOM, CEFCOM and the environmental Force Generators. A platform that can monitor and coordinate activity in the airspace and maritime approaches, AWACS brings with it the flexibility of maneuver. From

contributing to a ‘whole of government’ approach to a domestic crisis, to AABM within joint and combined combat operations, AWACS is a force multiplier that would further contribute to NORAD or NATO in time of crisis, or any other coalition Canada may join. From a FG and training perspective, AWACS is a critical enabler for advanced aerospace combat training, joint weapons and tactics training, joint interoperability testing and exercise support for weapons ranges. For Canada’s fighter force, CADS, naval and army AD units, this capability would be invaluable, as none of the initiatives concerning UAV, satellite, radar or modernized MPA address these core necessities. The GoC and CF need to consider acquiring this capability in conjunction with the other ongoing initiatives if serious about implementing the necessary strategy to achieve current national security policy and vision.

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